**National Marine Fisheries Service**
**Endangered Species Act Section 7 Consultation**

**Biological Opinion**

**Agency:** NOAA's National Marine Fisheries Service-Office of Protected Resources-Permits, Conservation, and Education Division

**Activities Considered:** Issuance of permit to Dan Forster, Georgia Department of Natural Resources, Wildlife Resources Division [Permit No. 15488]

**Consultation Conducted by:** NOAA's National Marine Fisheries Service-Office of Protected Resources-Endangered Species Division

**Approved by:**

**Date:** JUN 2 3 2011

Section 7(a)(2) of the Endangered Species Act (ESA)(16 U.S.C. 1531 *et seq.*) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency "may affect" a listed species or critical habitat designated for them, that agency is required to consult with either the NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected. For the actions described in this document, the action agency is the NMFS' Office of Protected Resources-Permits, Conservation, and Education Division (Permits Division), which proposes to authorize close approach, aerial survey, and biopsy North Atlantic right whales in the North Atlantic Ocean from South Carolina south through Florida and into the Gulf of Mexico. The consulting agency for these proposals is the NMFS' Office of Protected Resources – Endangered Species Division.

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed actions on endangered and threatened species and designated critical habitat and has been prepared in accordance with section 7 of the ESA. This Opinion is based on information provided in the application, draft permit, environmental assessment, recovery plan for North Atlantic right whales, the most current marine mammal stock assessment reports, past and current research and population dynamics modeling efforts, monitoring reports from prior research, other information provided by the applicant, and other biological opinions involving similar marine mammal research.

## Consultation history

On December 3, 2010, the Permits Division published a notice in the Federal Register soliciting public comment on their intent to issue the proposed permit.

On February 18, 2011, NMFS' Endangered Species Division received a request for formal consultation from the Permits Division to authorize Permit Number 15488, Dan Forster, Georgia Department of Natural Resources, Wildlife Resources Division. Consultation was initiated on this date.

## Description of the proposed action

The Georgia Department of Natural Resources, Wildlife Resources Division (GDNR-WRD) proposes to conduct several research projects on North Atlantic right whales that would facilitate monitoring and better understanding of species demographics and recovery. Aerial surveys would count individuals in designated survey areas and photoidentify individuals, allowing for individuals within the population to be tracked non-invasively through time and, for females, monitoring reproductive success. Aerial surveys would also aide in spotting whales for small vessels, which would deviate from tracklines and engage in photoidentification (vessel-based perspectives usually required to conclusively identify an individual) as well as behavioral observations and biopsy sampling. Biopsy sampling would facilitate multiple studies, including the genotyping of individuals (particularly calves and juveniles) to identify parental lineages, aide in individual identification (for several years, calves and juveniles are usually not readily individually identifiable due to lack of scars, callosities, and other markings used to differentiate individuals), and determine age later in life if they are re-sampled or matched to photoidentification catalogs. No tagging of any kind would be authorized under the proposed permit.

Aerial surveys are typically conducted from an Aero Commander 680 or NOAA twin otter aircraft along preplanned tracklines, but deviations to investigate and circle North Atlantic right whale sightings typically occur. Flight duration is typically six hours, but can be significantly longer. Flight altitude varies based upon project, but can range from ~100-500 m and are typically flown at ~305 m, although temporary descent to 274 m for photography would be permitted. Speed is usually 185 km/hr. During this time, photographs and sighting documentation are recorded from the plane Aerial surveys would also be conducted to assist surface vessels in locating target individuals. In this situation, a survey aircraft would fly transect tracklines until a target individual is identified. The survey aircraft would circle or otherwise maintain contact with the individual until the vessel arrives, which could engage in photoidentification and biopsy sampling. If a marine mammal is observed to respond to the survey aircraft, the proposed permit requires that the aircraft must immediately leave the area.

Vessel surveys are also conducted along pre-planned tracklines, but the vessel may deviate from its course to investigate a marine mammal sighting. Vessels would generally be NOAA-owned twin outboard Zodiac rigid-hull-inflatable-boats, although other small outboard vessels may also be used. Marine mammals would be followed and approached to obtain photoidentification records and biopsy samples of a target individual(s). Survey vessels would preferably approach from behind or alongside a target individual or group, with a minimum of course and speed changes, and at a speed

that does not rapidly overtake a target individual or group. Approaches for photoidentification or biopsy would close to within 7-30 m. Approaches for these purposes generally do not last more than 30 minutes for a target individual, although approaches of groups may take longer to photograph and biopsy other potential target individuals in the group. The proposed permit would limit approaches of cow/calf pairs (which are of particular interest to the applicants) to 30 minutes. However, approaches may also occur as focal follows to collect behavioral data over longer durations. In these cases, approaches may last one to two hours, but would be conducted from a greater distance (up to 450 m away). The proposed permit would limit approaches of an individual to no more than three per day.

Biopsy sampling would be conducted during some close approaches. Crossbows would be used to deploy arrows with biopsy tips (0.7 mm diameter, 2.5 cm depth). A stopper on the arrow would prevent excessive penetration into blubber and make the arrow float after bouncing off the target individual. Biopsy tips would be disinfected in successive exposures to bleach and ethyl alcohol prior to deployment. All age classes except neonates less than one month of age could be sampled. Although age determination to within days is not feasible for North Atlantic right whales, several methods would be used to determine whether an individual is old enough to be biopsied. These include the presence of fetal folds and documentation of when the calf was first seen with its mother (Clay George, GDNR-WRD, pers. comm.). Adult females accompanied by calves would also be biopsied. Biopsy attempts must be discontinued if a strong adverse reaction is observed. Research on North Atlantic right whales is highly coordinated between NOAA regional office and science centers and field researchers, including daily communication updating all parties as to the activities performed on individuals of the species. As such, field personnel are provided with daily to hourly updates of activities performed and, as standard practice, refer to current documents and catalogs before engaging in activities such as biopsy sampling.

The Permits Division also intends to modify an existing permit (775-1875) to decrease the number of biopsies authorized if the proposed permit is issued. Presently, the applicant is a co-investigator on permit 775-1875 and is seeking a permit to support the same work as is presently being conducted, but under separate authorization. The reduction in biopsies authorized under permit 775-1875 would not entail reinitiation of consultation under the ESA and thus is not discussed further in this opinion. This action would serve to limit the cumulative number of authorized biopsy events on North Atlantic right whales to a maximum of 60 annually.

## Approach to the Assessment

The NMFS approaches its section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The result of this step includes defining the *action area* for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *exposure analyses*). In this step of our analyses, we try to identify the number, age

(or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *response analyses*).

The final steps of our analyses – establishing the risks those responses pose to listed resources – are different for listed species and designated critical habitat (these represent our *risk analyses*). Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. The continued existence of these "species" depends on the fate of the populations that comprise them. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the individuals' "fitness," or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable lethal, sub-lethal, or behavioral responses to an action's effect on the environment (which we identify during our response analyses) are likely to have consequences for the individual's fitness.

When individual, listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (see Stearns 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a *necessary* condition for reductions in a population's viability, which is itself a *necessary* condition for reductions in a species' viability. As a result, when listed plants or animals exposed to an action's effects are *not* expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if we conclude that listed plants or animals are *not* likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals is a *necessary* condition for reductions in a population's viability, reducing the fitness of individuals in a population is not always

*sufficient* to reduce the viability of the population(s) those individuals represent. Therefore, if we conclude that listed plants or animals are likely to experience reductions in their fitness, we determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the population's base condition (established in the *Environmental baseline* and *Status of listed resources* sections of this Opinion) as our point of reference. If we conclude that reductions in individual fitness are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

Reducing the viability of a population is not always *sufficient* to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population's viability are likely to reduce the viability of the species those populations comprise using changes in a species' reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species' status (established in the *Status of listed resources* section of this Opinion) as our point of reference. Our final determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

To conduct these analyses, we rely on all of the evidence available to us. This evidence consists of monitoring reports submitted by past and present permit holders, reports from NMFS Science Centers; reports prepared by natural resource agencies in States and other countries, reports from non-governmental organizations involved in marine conservation issues, the information provided by the Permits Division when it initiates formal consultation, and the general scientific literature.

We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies like the Minerals Management Service, U.S. Coast Guard, and U.S. Navy whose operations extend into the marine environment.

During the consultation, we conducted electronic searches of the general scientific literature using search engines, including Agricola, Ingenta Connect, Aquatic Sciences and Fisheries Abstracts, JSTOR, Conference Papers Index, First Search (Article First, ECO, WorldCat), Web of Science, Oceanic Abstracts, Google Scholar, and Science Direct.

We supplemented these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically tried to identify data or other information that supports a particular conclusion (for example, a study that suggests whales will exhibit a particular response to close vessel approach) as well as data that do not support that conclusion. When data were equivocal or when faced with substantial uncertainty, our decisions are designed to avoid the risks of incorrectly concluding that an action would not have an adverse effect on listed species when, in fact, such adverse effects are likely (i.e., Type II error).

## Action Area

The proposed action area includes a broad coastal region of the North Atlantic from South Carolina south around Florida into the Gulf of Mexico to the Florida-Alabama border, extending throughout the U.S. Exclusive Economic Zone (200 nmi). The applicant would be permitted to conduct research from the beginning of November to the end of April each year for the duration of the permit.

## Status of Listed Resources

The NMFS has determined that the actions considered in this Opinion may affect species listed in Table 1, which are provided protection under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.).

**Table 1.** Listed resources in the action area. Asterisks denote critical habitat in the action area.

| ***Common Name (Distinct Population Segment, Evolutionarily Significant Unit, or Subspecies)*** | ***Scientific Name*** | ***Status*** |
|---|---|---|
| ***Cetaceans*** | | |
| Blue whale | *Balaenoptera musculus* | Endangered |
| Fin whale | *Balaenoptera physalus* | Endangered |
| Humpback whale | *Megaptera novaeangliae* | Endangered |
| North Atlantic right whale* | *Eubalaena glacialis* | Endangered |
| Sei whale | *Balaenoptera borealis* | Endangered |
| Sperm whale | *Physeter macrocephalus* | Endangered |
| ***Marine Turtles*** | | |
| Green sea turtle (Florida & Mexico's Pacific coast colonies) | *Chelonia mydas* | Endangered |
| Green sea turtle (All other areas) | | Threatened |
| Hawksbill sea turtle | *Eretmochelys imbricate* | Endangered |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | Endangered |
| Leatherback sea turtle | *Dermochelys coriacea* | Endangered |
| Loggerhead sea turtle | *Caretta caretta* | Threatened |
| Olive ridley sea turtle (non-Mexico's Pacific coast breeding colonies) | *Lepidochelys olivacea* | Threatened |
| ***Anadromous Fishes*** | | |
| Shortnose sturgeon | *Acipenser brevirostrum* | Endangered |
| Smalltooth sawfish* | *Pristis pectinata* | Endangered |
| ***Marine Invertebrates*** | | |
| Elkhorn coral* | *Acropora palmata* | Threatened |
| Staghorn coral* | *Acropora cervicornis* | Threatened |
| ***Proposed for listing*** | | |
| Atlantic sturgeon (Carolina) | *Asipenser oxyrinchus* | Proposed Endangered |

### Species not considered further

Blue, fin, humpback, sei, and sperm whales may be incidentally exposed to stressors associated with the proposed action, such as ship-strike and acoustic noise exposure. Personnel onboard research vessels would continually observe for cetaceans and actively avoid approaching non-target individuals. This, combined with the thousands of hours that researchers have spent in vessel-based research effort over several years in the region

without an incident of ship-strike make the possibility of ship-strike insignificant. The research vessels would produce noise in the acoustic environment which has the potential to mask the vocalizations produced by listed whales or other significant acoustic information, introducing the possibility that important sounds may not be perceived by individuals near the research vessel (particularly when operating at high speed). However, researchers would be visually searching for cetaceans and avoiding close approaches of all but target individuals. Exposure to masking sounds is expected to be brief and insignificant to non-target, listed cetaceans.

Sea turtles would be exposed to vessel strikes. As with marine mammals, sea turtles have not been documented to be struck by researchers in the area and the possibility of this occurring is insignificant. Listed sturgeon and sturgeon proposed for listing may also be exposed to potential stressors from the proposed actions. Sturgeon tend to be epibenthic in marine waters and we do not expect co-occurrence with vessels at the surface. We similarly do not expect smalltooth sawfish to be exposed to the potential for ship strike. We therefore find the potential for direct strike to sturgeon and smalltooth sawfish to be insignificant. For these reasons, these species will not be considered further in this opinion.

Although listed invertebrates (elkhorn and staghorn coral) would co-occur with the proposed actions, we cannot identify any stressors that reasonably could impact their biology. We therefore find stressors to be insignificant for these listed species. For these reasons, these species will not be considered further in this opinion.

Although critical habitat has been defined for North Atlantic right whales and smalltooth sawfish, primary constituent elements were not identified in the listing. However, these areas were identified as being significant to breeding and nursing. We do not expect any stressors associate with the proposed research to influence the quality of smalltooth sawfish critical habitat. Although some actions have the potential to disrupt breeding and rearing of North Atlantic right whales (explained in the Effects analysis), we do not expect stereos of the proposed research to influence the overall quality or quantity of the available critical habitat. The lone primary constituent element associated with elkhorn and staghorn critical habitat is natural consolidated hard substrate or dead coral skeleton that are free from fleshy or turf macroalgae cover and sediment cover to enable recruitment of new coral polyps. We do not expect that the proposed actions will impact this primary constituent. We therefore find risk to critical habitat to be insignificant.

The biology and ecology of species with anticipated exposure below (North Atlantic right whales) informs the effects analysis for this Opinion. Summaries of the global status and trends of each species presented provide a foundation for the analysis of species as a whole.

## North Atlantic right whale

**Description of the species.** All North Atlantic right whales compose a single population. Although not all individuals undergo the same migratory pattern, no subpopulation structuring has been identified.

**Distribution.** Right whales occur in sub-polar to temperate waters in all major ocean basins in the world, with a clear migratory pattern of high latitudes in summer and lower

latitudes in winter (Cummings 1985; Perry et al. 1999; Rice 1998). The historical range of North Atlantic right whales extended as far south as Florida and northwestern Africa, and as far north as Labrador, southern Greenland, Iceland, and Norway (Cummings 1985; Reeves et al. 1978; Rice 1998). Most sightings in the western North Atlantic are concentrated within five primary habitats or high-use areas: coastal waters of the southeastern U.S., Cape Cod and Massachusetts Bays, the Great South Channel, the Bay of Fundy, and the Scotian Shelf (Winn et al. 1986). In 1994, the first three of these areas were designated as critical habitat for the North Atlantic right whale.

North Atlantic right whales have been observed from the mid-Atlantic Bight northward through the Gulf of Maine year-round, but are primarily found along the northeast U.S. during summer and Florida during winter, with migratory routes in between. In New England, peak abundance of North Atlantic right whales in feeding areas occurs in Cape Cod Bay beginning in late winter. In early spring (Late February to April), peak North Atlantic right whale abundance occurs in Jordan and Wilkinson basins to the Great South Channel (Kenney et al. 1995; Nichols et al. 2008; Pace III and Merrick 2008). In late June and July, North Atlantic right whale distribution gradually shifts to the northern edge of Georges Bank. In late summer (August) and fall, much of the population is found in waters in the Bay of Fundy, the western Gulf of Maine and around Roseway Basin (Kenney et al. 2001; Kenney et al. 1995; Pace III and Merrick 2008; Winn et al. 1986). However, year-to-year variation in space and time are known and likely result from patchy prey distribution (Nichols et al. 2008). Variation in the abundance and development of suitable food patches appears to modify the general patterns of movement by reducing peak numbers, stay durations and specific locales (Brown et al. 2001; Kenney 2001). In particular, large changes in the typical pattern of food abundance will dramatically change the general pattern of North Atlantic right whale habitat use (Kenney 2001).

During winter, many individuals migrate to southern coastal waters between North Carolina and Florida for breeding and calving, where critical habitat is designated for these purposes (Winn et al. 1986). Calving generally occurs between December and March in this area (Silber and Clapham 2001). However, most individuals no not undergo this migration yearly, but remain in northern feeding locations or presumably disperse in offshore waters of the North Atlantic (Kraus et al. 1986).

**Migration and movement.** North Atlantic right whales exhibit extensive migratory patterns, traveling along the eastern seaboard of the U.S. and Canada between calving grounds off Georgia and Florida to northern feeding areas off of the northeast U.S. and Canada in March/April and the reverse direction in November/December (Winn et al. 1986). The longest tracking of a North Atlantic right whale was a migration of 1,900 km in 23 days the Bay of Fundy to Georgia (Mate and Baumgartner 2001). Migrations are typically within 30 nautical miles of the coastline and in waters less than 50 m deep. Although this pattern is well-known, most of the population, particularly the males and non-pregnant females, is not found in the calving area and may not follow this pattern. It is unknown where the majority of the non-calving population spends the winter.

There have been a few recent sightings of North Atlantic right whales far offshore, including those from Dutch ships indicating some individuals occur between 40° and 50°N, in waters influenced by the North Atlantic Current (the broad, eastward-flowing

extension of the Gulf Stream). Right whales have been sighted offshore (greater than 50 m) during surveys flown off the coast of northeastern Florida and southeastern Georgia from 1996 to 2001. These include three sightings in 1996, one in 1997, 13 in 1998, six in 1999, 11 in 2000, and six in 2001 (within each year, some were repeat sightings). Mate et al. (1997a) recorded radio-tagged animals making extensive movements from the Gulf of Maine into deeper waters off the continental shelf (Mate et al. 1997a). The frequency with which North Atlantic right whales occur in offshore waters in the southeastern U.S. remains unclear. Occasionally, individuals are observed in distant locations, including the Gulf of Mexico, Bermuda, the Gulf of St. Lawrence, Newfoundland, Greenland, Iceland, and northern Norway (an area known as a historical North Atlantic right whale feeding area Smith et al. 2006). The Norwegian sighting (September 1992) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described.

**Reproduction and demography.** Data through the 1990s suggests that mean calving interval increased since 1992 from 3.67 years to more than five years, a significant trend that hampers North Atlantic right whale recovery (Best et al. 2001a; Kraus et al. 2007). This reproductive rate was approximately half that reported from studied populations of southern right whales (Best et al. 2001b). This has been attributed to several possible causes, including higher abortion or perinatal losses (Browning et al. 2009). An analysis of the age structure of North Atlantic right whales suggests that the population contains a smaller proportion of juvenile whales than expected, which may reflect lowered recruitment and/or high juvenile mortality (Best et al. 2001a; Hamilton et al. 1998). In addition, it is possible that the apparently low reproductive rate is due in part to unstable age structure or to reproductive senescence on the part of some females. However, knowledge on either factor is poor. Even though investment in calves is high for North Atlantic right whales, an incident of calf exchange (probably accidentally and soon after birth) and subsequent adoption through weaning has been found (Frasier et al. 2010). Although North Atlantic right whales historically separated from their calves within one year, a shift appears to have taken place around 2001 where mothers (particularly less experienced mothers) return to wintering grounds with their yearling at a much greater frequency (71% overall)(Hamilton and Cooper. 2010). The significance of this change is unknown.

**Habitat.** Available evidence from North Atlantic right whale foraging and habitat studies shows that North Atlantic right whales focus foraging activities where physical oceanographic features such as water depth, current, and mixing fronts combine to concentrate copepods (Baumgartner et al. 2003; Mayo and Marx 1990; Murison and Gaskin 1989; Wishner et al. 1988). While on calving grounds, individuals tend to remain in nearshore waters, possibly in association with cooler sea surface temperatures (Kraus et al. 1993b; Ward 1999). Habitat in this area can also extend north of the designated critical habitat, possibly as a result of sea surface temperature shifts (Garrison 2007; Glass et al. 2005).

**Feeding.** North Atlantic right whales fast during the winter and feed during the summer, although some may opportunistically feed during migration. North Atlantic right whales

use their baleen to sieve copepods from dense patches, found in highly variable and spatially unpredictable locations in the Bay of Fundy, Roseway Basin, Cape Cod Bay, the Great South Channel, and other areas off northern U.S. and Canada (Pendleton et al. 2009). The primary prey of North Atlantic right whales is zooplankton, especially shrimp-like copepods such as *Calanus* (Beardsley et al. 1996; Kenney et al. 1985). North Atlantic right whales feed largely by skimming these prey from the ocean surface (Mayo and Marx 1990; Pivorunas 1979), but may feed anywhere in the water column (Goodyear 1993a; Watkins and Schevill 1976; Watkins and Schevill 1979; Winn et al. 1995). Feeding behavior has only been observed in northern areas and not on calving grounds or during migration (Kraus et al. 1993a).

**Diving.** Although North Atlantic right whales are known to be primarily surface feeders, foraging dives frequently extend to the deepest layers of the water column (Baumgartner et al. 2003; Goodyear 1993a; Mate et al. 1997a). North Atlantic right whale feeding dives are characterized by a rapid descent from the surface to between 80 and 175 m, where dives level off and individuals remain for five to 14 minutes before rapidly ascending back to the surface (Baumgartner and Mate 2003a). Dive depth has been shown to be strongly correlated with the depth of peak copepod abundance (Baumgartner and Mate 2003a). Prolonged periods at the surface have been noted for mothers and calves (Baumgartner and Mate 2003a). Shallow foraging dives in the Great South Channel average two minutes and 6-8 m (Winn et al. 1995). However, dives along the outer shelf average seven minutes (CETAP 1982). Although North Atlantic right whales are not champion divers, they can dive to over 300 m (Mate et al. 1992). Group size varies, but is generally less than one dozen and singletons and pairs are most frequently observed (Jefferson et al. 1993).

**Acoustics and hearing.** North Atlantic right whales produce a variety of sounds with frequencies of 0.02-15 kHz (dominant energy up to 2 kHz), lasting 0.01 to several seconds at estimated source amplitudes of 137-192 dB re 1 μPa-m (Parks and Clark 2007; Parks et al. 2005; Parks and Tyack. 2005). Vocalizations include moans, screams, gunshots, blows, upcalls, downcalls, and warbles (Laurinolli et al. 2003; Matthews et al. 2001; Parks et al. 2005; Parks and Tyack. 2005; Vanderlaan et al. 2003). A diel pattern, with more vocalizations during night than day, has been observed and theorized to correlate to the diel migration of zooplankton (Baumgartner et al. 2005)(Leaper and Gillespie 2006).

Although data on North Atlantic right whale acoustics and hearing is relatively poorly known, these aspects of southern right whales (a closely-related species) have been studied in more detail. Southern right whales are known to produce a variety of low-frequency vocalizations on breeding groups (Clark 1982a; Clark 1983). The most common is an “up” call (50-200 Hz with a frequency modulated upsweep) that appears to establish contact and aggregate individuals (Clark 1982a; Clark 1983; Dunshea and Gedamke. 2010). Blows (100-400 Hz), apart from their respiratory function, may signal calves to remain close or inform approaching animals to stay away (particularly loud, pulsitive, or tonal blows) (Clark 1981; Clark 1982b; Clark 1983). Slaps (50-1,000 Hz), “pulsitive” and “hybrid” (both complex 50-200 Hz) calls may have a threat, antagonism, or aggressive function in sexually active groups, but little or no communicative function in other groups (Clark 1981; Clark 1982b; Clark 1983). “Down” calls (100-200 Hz with

frequency modulated downsweep) seem to have a similar function as "up" calls, but are produced by more excited individuals (Clark 1981; Clark 1982b; Clark 1983). "High" calls may indicate an excited individual, excite other individuals, or attract whales to a group (Clark 1981; Clark 1982b; Clark 1983). Resting and swimming groups are silent most of the time; resting groups do make "blow" sound, though, and resting individuals may make "up" calls (Clark 1981; Clark 1983). Swimming groups make "up" calls more than any other sound (Clark 1981; Clark 1983). As physical activity increases, so does the level of vocal activity (Clark 1981; Clark 1983). Mildly active groups were silent only one-quarter of the time and made large numbers of "slap" sounds by striking flukes or flippers on the water surface (Clark 1981; Clark 1983). Highly-active groups are rarely silent and make numerous slaps, blows, as well as, "up", "hybrid", "high", and "pulsivite" calls (Clark 1981; Clark 1983). Sexually active groups have not been documented to make "up" calls or be silent, but make extensive "hybrid", "high", and "pulsivite" calls (Clark 1981; Clark 1983). "Up" calls have also been recorded during winter on feeding grounds (Sirovic et al. 2006).

No individual has been tested for its hearing sensitivity. As such, we have no experimental data to support the range of hearing. However, anatomical studies of the inner ear of right whale have been used to suggest a hearing range of 0.01-22 kHz (Parks and Clark 2007; Parks et al. 2004; Parks and Tyack. 2005). Sound exposure to tones of 0.5-4.5 kHz at received levels of 133-148 dB re 1 μPa-m have produced behavioral responses in free-ranging individuals (Nowacek et al. 2004b).

**Status and trends.** The Northern right whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973. The early listing included both the North Atlantic and the North Pacific populations, although subsequent genetic studies conducted by Rosenbaum (2000) resulted in strong evidence that North Atlantic and North Pacific right whales are separate species. Following a comprehensive status review, NMFS concluded that North Atlantic and North Pacific right whales are separate species. In March 2008, NMFS published a final rule listing North Pacific and North Atlantic right whales as separate species (73 FR 12024).

North Atlantic right whales were formerly abundant, with an estimated 5,500 individuals present in the 16$^{th}$ century throughout the North Atlantic (Reeves 2001; Reeves et al. 2007). A review of the photo-id recapture database in June 2006, indicated that only 313 individually recognized North Atlantic right whales were observed during 2001. This represents a nearly complete census, and the estimated minimum population size. However, no estimate of abundance with an associated coefficient of variation has been calculated for the population. The extreme contraction of population size has reduced the genetic diversity of North Atlantic right whales, but does not appear at present to be causing inherent demographic stochasticity problems, such as Allee effects or inbreeding (IWC 2001; Malik et al. 2000; Schaeff et al. 1997). The population growth rate reported for the period 1986 to 1992 by Knowlton et al. (1994) was 2.5%, suggesting the stock was showing signs of slow recovery. However, work by Caswell et al. (1999) suggested that crude survival probability declined from about 0.99 in the early 1980's to about 0.94 in the late 1990s. Additional work conducted in 1999 showed that survival had indeed declined in the 1990s, particularly for adult females (Best et al. 2001a). Another

workshop in September 2002 further confirmed the decline in this population (Clapham 2002). Currently, a minimum of 345 individuals are believed to compose the species (Waring et al. 2009).

Mortality, particularly due to anthropogenic sources, is likely a major driver to the decline and lack of recovery for North Atlantic right whales. Kraus (1990) estimated first year mortality at 17% for calves, which declined to roughly 3% annually for 2-4 year old individuals and 27% overall for individuals under four years of age. The deaths of adult females is particularly concerning, as the loss of these individuals has a disproportionally large effect of reducing the overall ability of the species to grow (Fujiwara and Caswell 2001). This, combined with the long-lived, late-maturing nature and reliance on high juvenile survival make the North Atlantic right whales especially susceptible to decline due to anthropogenic threats, such as whaling, ship strike, and gear entanglement.

**Natural threats.** Several researchers have suggested that the recovery of North Atlantic right whales has been impeded by competition with other whales for food (Rice 1974; Scarff 1986). Mitchell (1975) analyzed trophic interactions among baleen whales in the western North Atlantic and noted that the foraging grounds of North Atlantic right whales overlapped with the foraging grounds of sei whales. Both species feed preferentially on copepods. Reeves et al. (1978) noted that several species of whales feed on copepods in the eastern North Pacific, so that the foraging pattern and success of right whales would be affected by other whales as well. Mitchell (1975) argued that the North Atlantic right whale population had been depleted by several centuries of whaling before steam-driven boats allowed whalers to hunt sei whales; from this, he hypothesized that the decline of the right whale population made more food available to sei whales and helped their population to grow. He then suggested that competition with the sei whale population impedes or prevents the recovery of the right whale population.

Other natural factors influencing right whale recovery are possible, but unquantified. Right whales have been subjects of killer whale attacks and, because of their robust size and slow swimming speed, tend to fight killer whales when confronted (Ford and Reeves 2008). Similarly, mortality or debilitation from disease and red tide events are not known, but have the potential to be significant problems in the recovery of right whales because of their small population size.

**Anthropogenic threats.** Several human activities are known to threaten North Atlantic right whales: whaling, commercial fishing, shipping, and environmental contaminants. Historically, whaling represented the greatest threat to every population of right whales and was ultimately responsible for listing right whales as an endangered species. As its legacy, whaling reduced North Atlantic right whales to about 300 individuals in the western North Atlantic Ocean; the number of North Atlantic right whales in the eastern North Atlantic Ocean is probably much smaller, although we cannot estimate the size of that population from the data available.

Of the current threats to North Atlantic right whales, entanglement in commercial fishing gear and ship strikes pose the greatest threats. Along the Atlantic coast of the U.S. and the Maritime Provinces of Canada, there were 43 reports of North Atlantic right whales entangled in fishing gear between 1999 and 2005 (Cole et al. 2005a; Nelson et al. 2007b). Of the 39 reports that NMFS could confirm, North Atlantic right whales were injured in

five of the entanglements and killed in four entanglements. Recent efforts to disentangle right whales have met with success (Anonmyous. 2009). In the same region, there were 18 reports of North Atlantic right whales being struck by vessels between 1999 and 2005 (Cole et al. 2005a; Nelson et al. 2007b). Of the 17 reports that NMFS could confirm, right whales were injured in two of the ship strikes and killed in nine. Present recommendations for slower vessel speeds in the Bay of Fundy appear to be largely ignored (Vanderlaan et al. 2008b). Proposed rules for seasonal (June through December) slowing of vessel traffic to 10 knots or changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to be capable of reducing ship strike mortality by 62% in the Bay of Fundy region.

Concern also exists over climate change and its effect on the ability of North Atlantic right whales to recover (Greene et al. 2003b). Specifically, the variations in oceanography resulting from current shifts and water temperatures can significantly affect the occurrence of the North Atlantic right whale's primary food, copepod crustaceans. If climate changes such that current feeding areas cannot sustain North Atlantic right whales, the population may have to shift to reflect changes in prey distribution, pursue other prey types, or face prey shortage. Changes in calving intervals with sea surface temperature have already been documented for southern right whales (Leaper et al. 2006).

North Atlantic right whales, as with many marine mammals, are exposed to numerous toxins in their environment, many of which are introduced by humans. Levels of chromium in North Atlantic right whale tissues are sufficient to be mutagenic and cause cell death in lung, skin, or testicular cells and are a concern for North Atlantic right whale recovery (Chen et al. 2009; Wise et al. 2008). The organochlorines DDT, DDE, PCBs, dieldrin, chlordane, HCB, and heptachlor epoxide have been isolated from blubber samples and reported concentrations may underestimate actual levels (Woodley et al. 1991). Mean PCB levels in North Atlantic right whales are greater than any other baleen whale species thus far measured, although less than one-quarter of the levels measured in harbor porpoises (Gauthier et al. 1997; Van Scheppingen et al. 1996). Organochlorines and pesticides, although variable in concentration by season, do not appear to currently threaten North Atlantic right whale health and recovery (Weisbrod et al. 2000). Flame retardants such as PBDEs (known to be carcinogenic) have also been measured in North Atlantic right whales (Montie et al. 2010).

**Critical habitat.** Critical habitat is designated for right whales in the North Atlantic. NMFS designated three areas in June 1994 as critical habitat for *Eubalaena glacialis* for feeding and calving (59 FR 28805). The critical habitats for feeding cover portions of the Great South Channel (east of Cape Cod), Massachusetts Bay and Cape Cod Bay, and Stellwagen Bank. Northern critical habitat was designated because of the concentration of right whales that feed in the area, apparently associated with complex oceanographic features that drive prey density and distribution. This area has come under considerable scrutiny within the past few years because of the concern over ship strikes in this area. Boston serves as a major port facility and vessels transiting to and from the port cross critical habitat where North Atlantic right whale mortality occurs. Shipping traffic has generally increased in the recent past and could be considered to degrade the habitat due to the additional mortality and injury risk now present in the area. Although voluntary

regulations are in place, these are frequently ignored and mandatory regulations are under consideration. The southern critical habitats are along Georgia and northeastern Florida coasts (waters from the coast out 15 nautical miles between the latitudes of 31°15' N and 30°15' N and from the coast out five nautical miles between 30°15' N and 28°00' N). Southern critical habitat is designated to protected calving and breeding grounds for North Atlantic right whales, which generally calve and breed in shallow coastal waters. This critical habitat has generally faired better than northern critical habitat and significant degradation has not been clearly identified.

**Environmental Baseline**

By regulation, environmental baselines for Opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). The *Environmental baseline* for this Opinion includes the effects of several activities affecting the survival and recovery of ESA-listed species in the action area and their critical habitats.

## Climate change

In general, based on forecasts made by the Intergovernmental Panel on Climate Change (IPCC), climate change is projected to have substantial effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the near future (IPCC 2000; IPCC 2001a; IPCC 2001b; IPCC 2002). From 1906 to 2006, global surface temperatures have risen 0.74º C and continue to rise at an accelerating pace; 11 or the 12 warmest years on record since 1850 have occurred since 1995 and the past decade has been the warmest in instrumental history (Arndt et al. 2010; Poloczanska et al. 2009). Furthermore, the Northern Hemisphere (where a greater proportion of ESA-listed species occur) is warming faster than the Southern Hemisphere, although land temperatures are rising more rapidly than over the oceans (Poloczanska et al. 2009). Climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level. Sea levels have risen an average of 1.7 mm/year over the 20$^{th}$ century and 3.3 mm/year between 1993 and 2006 due to glacial melting and thermal expansion of ocean water; this rate will likely increase, which is supported by the latest data from 2009 (Arndt et al. 2010; Hoegh-Guldberg and Bruno 2010; Wilkinson and Souter 2008). Oceanographic models project a weakening of the thermohaline circulation resulting in a reduction of heat transport into high latitudes of Europe, an increase in the mass of the Antarctic ice sheet, and a decrease in the Greenland ice sheet, although the magnitude of these changes remain unknown. Reductions in ozone and subsequent increases in ultraviolet radiation have been linked to possible skin damage and blistering in blue, fin, and sperm whales in the Gulf of California (Martinez-Levasseur et al. 2010).

Climate change has been linked to changing ocean currents as well. Rising carbon dioxide levels have been identified as a reason for a poleward shift in the Eastern Australian Current, shifting warm waters into the Tasman Sea and altering biotic features of the area (Poloczanska et al. 2009). Similarly, the Kuroshio Current in the western

North Pacific (an important foraging area for juvenile sea turtles and other listed species) has shifted southward as a result of altered long-term wind patterns over the Pacific Ocean (Poloczanska et al. 2009).

Climate change would result in changes in the distribution of temperatures suitable for whale calving and rearing, the distribution and abundance of prey, and abundance of competitors or predators. For species that undergo long migrations, individual movements are usually associated with prey availability or habitat suitability. If either is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009). Climate change can influence reproductive success by altering prey availability, as evidenced by high survival of northern elephant seal pups during El Niño periods, when cooler, more productive waters are associated with higher first-year pup survival (McMahon and Burton. 2005). Reduced prey availability resulting from increased sea temperatures has also been suggested to explain reductions in Antarctic fur seal pup and harbor porpoise survival (Forcada et al. 2005; Macleod et al. 2007). Primary production is estimated to have declined by 6% between the early 1980s and 2010 partly as a result of climactic shifts, making foraging more difficult for marine species (Hoegh-Guldberg and Bruno 2010). Polygamous marine mammal mating systems can also be perturbated by rainfall levels, with the most competitive grey seal males being more successful in wetter years than in drier ones (Twiss et al. 2007). Sperm whale females were observed to have lower rates of conception following unusually warm sea surface temperature periods (Whitehead 1997). Marine mammals with restricted distributions linked to water temperature may be particularly exposed to range restriction (Issac 2009; Learmonth et al. 2006). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88% of cetaceans would be affected by climate change, 47% would be negatively affected, and 21% would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats, such as North Atlantic right whales (Macleod 2009). Variations in the recruitment of krill and the reproductive success of krill predators correlate to variations in sea-surface temperatures and the extent of sea-ice cover age during winter months. Although the IPCC (2001b) did not detect significant changes in the extent of Antarctic sea-ice using satellite measurements, Curran et al. (2003) analyzed ice-core samples from 1841 to 1995 and concluded Antarctic sea ice cover had declined by about 20% since the 1950s.

Physical changes in the ocean associated with warming include increases in temperature, increased water column stratification, and changes in the intensity and timing of coastal upwelling. These changes will alter primary and secondary productivity, the structure of marine communities, and, in turn, the growth, productivity, survival, and migrations of marine mammals, and other listed species. Energetic demands increase at warmer temperatures, requiring increased feeding to maintain growth. This could lead to intensified competition for food and reduction in growth rates, further exacerbating prey/predator relationships.

Foraging is not the only potential aspect that climate change could influence. Acevedo-Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence. Altered

ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Simmonds and Eliott. 2009). It has been suggested that increases in harmful algal blooms could be a result of increases in sea surface temperature (Simmonds and Eliott. 2009).

Species that are shorter-lived, have larger body sizes, or are generalist in nature are liable to be better able to adapt to climate change over the long term versus those that are longer-lived, smaller-sized, or rely upon specialized habitats (Brashares 2003; Cardillo 2003; Cardillo et al. 2005; Issac 2009; Purvis et al. 2000). Climate change is likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2008). As such, we expect the risk of extinction to listed species to rise with the degree of climate shift associated with global warming.

Concern also exists over climate change and its effect on the ability of North Atlantic right whales to recover (Greene et al. 2003b). Specifically, the variations in oceanography resulting from current shifts and water temperatures can significantly affect the occurrence of the North Atlantic right whale's primary food, copepod crustaceans. If climate changes such that current feeding areas cannot sustain North Atlantic right whales, the population may have to shift to reflect changes in prey distribution, pursue other prey types, or face prey shortage. Changes in calving intervals with sea surface temperature have already been documented for southern right whales (Leaper et al. 2006).

Climactic shifts also occur due to natural phenomenon. In the North Atlantic, this primarily concerns fluctuations in the North Atlantic Oscillation (NAO), which results from changes in atmospheric pressure between a semi-permanent high pressure feature over the Azores and a subpolar low pressure area over Iceland (Curry and McCartney 2001; Hurrell 1995; Stenseth et al. 2002). This interaction affects sea surface temperatures, wind patterns, and oceanic circulation in the North Atlantic (Stenseth et al. 2002). The NAO shifts between positive and negative phases, with a positive phase having persisted since 1970 (Hurrell 1995). North Atlantic conditions experienced during positive NAO phases include warmer than average winter weather in central and eastern North America and Europe and colder than average temperatures Greenland and the Mediterranean Sea (Visbeck 2002). Effects are most pronounced during winter (Taylor et al. 1998). The NAO is significant for North Atlantic right whales due to its influence on the species primary prey, zooplankton of the genus *Calanus*, which are more abundant in the Gulf of Maine during positive NAO years (Conversi et al. 2001; Drinkwater et al. 2003; Greene and Pershing 2004; Greene et al. 2003a; Kiszka et al. 2010). This subsequently impacts the nutritional state of North Atlantic right whales and the rate at which sexually mature females can produce calves (Greene et al. 2003a). Local distribution shifts of North Atlantic right whales may be tied to the NAO (Kenney 2007).

## Habitat degradation

A number of factors may be directly or indirectly affecting listed species in the action area by degrading habitat; perhaps most significant among them is anthropogenic noise in the ocean. Natural sources of ambient noise include: wind, waves, surf noise, precipitation, thunder, and biological noise from marine mammals, fishes, and

crustaceans. Anthropogenic sources of ambient noise include: transportation and shipping traffic, dredging, construction activities, geophysical surveys, and sonars. In general, it has been asserted that ocean background noise levels have doubled every decade for the last six decades in some areas, primarily due to shipping traffic (IWC 2004). The acoustic noise that commercial traffic contributes to the marine environment is a concern for listed species because it may impair communication between individuals (Hatch et al. 2008).

Vessel noise could affect marine animals in the proposed study area. Shipping and seismic noise generally dominates ambient noise at frequencies from 20 to 300 Hz (Andrew et al. 2002; Hildebrand 2009; Richardson et al. 1995c). Background noise has increased significantly in the past 50 years as a result of increasing vessel traffic, and particularly shipping, with increases of as much as 12 dB in low frequency ranges and 20 dB versus preindustrial periods (Hildebrand 2009; Jasny et al. 2005; McDonald et al. 2006; NRC 1994; NRC 2003; NRC 2005; Richardson et al. 1995c). Over the past 50 years, the number of commercial vessels has tripled, carrying an estimated six times as much cargo (requiring larger, more powerful, and consequently louder vessels) (Hildebrand 2009). Seismic signals also contribute significantly to the low frequency ambient sound field (Hildebrand 2009). Baleen whales may be more sensitive to sound at those low frequencies than are toothed whales. Dunlop et al. (2010b) found that humpback whales shifted from using vocal communication (which carries relatively large amounts of information) to surface-active communication (splashes; carry relatively little information) when low-frequency background noise increased due to increased sea state. Sonars and small vessels also contribute significantly to mid-frequency ranges (Hildebrand 2009).

The northeastern U.S. hosts some of the busiest commercial shipping lanes in the world, including those leading into Boston, Providence, Newark, and New York (MARAD 2011). In addition, the Boston cruise ship terminal is growing rapidly and is currently one of the busiest cruise ship ports in the U.S. {Massport, 2002 #6}. In addition to vessel traffic, marine construction activities occur in the Cape Cod area (liquefied natural gas terminal construction, pile driving, offshore wind farm construction, dredging, cable laying, drilling, and others) that contributes to local and regional background sound levels.

In-water construction activities (e.g., pile driving associated with shoreline projects) in both inland waters as well as coastal waters in the action area can produce sound levels sufficient to disturb marine mammals under some conditions. Pressure levels from 190-220 dB re 1 μPa were reported for piles of different sizes in a number of studies (NMFS 2006). The majority of the sound energy associated with pile driving is in the low frequency range (<1,000 Hz) (Illingworth and Rodkin Inc. 2001; Illingworth and Rodkin Inc. 2004; Reyff 2003). Dredging operations also have the potential to emit sounds at levels that could disturb marine mammals. Depending on the type of dredge, peak sound pressure levels from 100 to 140 dB re 1 μPa were reported in one study (Clarke et al. 2003). As with pile driving, most of the sound energy associated with dredging is in the low-frequency range, <1000 Hz (Clarke et al. 2003).

Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of marine mammals to sound. For

example, a six-inch block of wood placed between the pile and the impact hammer used in combination with a bubble curtain can reduce sound pressure levels by about 20 dB (NMFS 2008b). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 dB lower than those generated by impact hammers (Nedwell and Edwards 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when marine mammals may be present; monitoring for marine mammals during construction activities; and maintenance of a buffer zone around the project area, within which sound-producing activities would be halted when marine mammals enter the zone (NMFS 2008b).

Oil spills could have a significant deleterious effect on marine mammals that are exposed to them. Exposure can occur via skin contact, ingestion of oil directly or through contaminated prey, or inspired while at the surface (Geraci 1990). This exposure could result in displacement of marine mammals from an impacted area or produce toxic effects. Perhaps the most famous shipwreck of all time occurred in the Gulf of Alaska when, in 1989, the *Exxon Valdez* released at least 11 million gallons of Alaskan crude oil into one of the largest and most productive estuaries in North America. The spill was the worst in U.S. history until the Deepwater Horizon event in 2010. The Alaska Department of Environmental Conservation estimated that 149 km of shoreline was heavily oiled and 459 km were at least lightly oiled. Oil spills, both small and large, occur widely along U.S. shores at refining and transfer facilities and extraction sites.

Ingestion of marine debris can have fatal consequences even for large whales. In 1989, a stranded sperm whale along the Mediterranean was found to have died from ingesting plastic that blocked its' digestive tract (Viale et al. 1992). A sperm whale examined in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990). The stomach contents of two sperm whales that stranded separately in California included extensive amounts of discarded fishing netting (NMFS 2009). A fifth individual from the Pacific was found to contain nylon netting in its stomach when it washed ashore in 2004 (NMFS 2009). Further incidents may occur but remain undocumented when carcasses do not strand.

## Entrapment/entanglement in fishing gear

Fisheries interactions are a significant problem for several marine mammals species and particularly so for North Atlantic right whales (Figure 1). Aside from the potential of entrapment and entanglement, there is also concern that many marine mammals that die from entanglement in commercial fishing gear tend to sink rather than strand ashore, thus making it difficult to accurately determine the frequency of such mortalities. Entanglement may also make whales more vulnerable to additional dangers, such as predation and ship strikes, by restricting agility and swimming speed. Along the Atlantic coast of the U.S. and the Maritime Provinces of Canada, there were 46 confirmed reports of North Atlantic right whales entangled in fishing gear between 1990 and 2007 (Cole et al. 2005a; Nelson et al. 2007b; Waring et al. 2009). Of the 39 reports that the NMFS could confirm, North Atlantic right whales were injured in five of the entanglements and killed in four entanglements. Three of the 24 entangled whales between 2004 and 2008 died and one other resulted in serious injury (Glass et al. 2009). Recent efforts to disentangle right whales have met with success (Anonmyous. 2009). However, over 60%

of the North Atlantic right whale population show some evidence of entanglement (Hamilton et al. 1998).

**Figure 1.** A North Atlantic right whale entangled in fisheries gear off Florida, with Georgia Department of Natural Resources and Coastwise Consulting staff attempting to cut rope off (Credit: EcoHealth Alliance and Georgia Department of Natural Resources, ESA permit number 932-1905).

## Seismic surveys and oil and gas production

Numerous surveys have been conducted in the northwest Atlantic using seismic airguns, and have the potential to affect ESA-listed seismic surveys. As a general mitigation measure, airguns are shutdown if marine mammals approach too closely, presumably avoiding the potential for temporary or permanent threshold shifts in their hearing. However, some species (such as bowhead whales) appear to be particularly sensitive to seismic, vessel, and industrial sound sounds and may move rapidly up to several kilometers away from the sound source (Gallagher and Hall. 1993; George 2010; Greene 1982; Richardson et al. 1995b; Richardson et al. 1985; Richardson et al. 1990; Richardson et al. 2004; Richardson and Williams 2003; Richardson and Williams 2004; Schick and Urban 2000; Streever et al. 2008; Wartzok et al. 1989). Other baleen whales frequently do the same (Malme et al. 1984; Malme et al. 1985; McCauley et al. 2000; McCauley et al. 1998a; McCauley et al. 1998b; Miller et al. 1999; Stone and Tasker 2006).

## In-water construction

Three large, in-water construction projects are known to be underway or underdevelopment that have the potential to impact North Atlantic right whales. A 130-turbine wind farm is proposed or reviewed for construction off Long Island, New York and another in Massachusetts Bay. Both projects would involve pile driving that produces large amounts of sound in the frequency range used by North Atlantic right whales. As this sound would likely persist for extended periods, there is the potential for North Atlantic right whales to abandon local areas in favor of areas where they can better used their primary mechanism for gaining information about their environment. Although neither area co-occurs locally with high North Atlantic right whale use, individuals do forage in waters near the Massachusetts site and may migrate past the New York site to and/or from their southeastern/northeastern U.S. breeding and foraging areas. In addition, a liquefied natural gas terminal is planned for construction off Gloucester, Massachusetts. This project would involve similar stressors, but located in prime North Atlantic right whale foraging habitat.

## Naval activities

Naval activity, notable sonar use during training exercises, has gained notoriety for its coincidence with marine mammal strandings. However, other activities (also during training exercises in designated naval operating areas and training ranges) also have the potential to adversely impact marine mammals. The action area overlaps several naval training ranges or facilities listed below. Listed individuals travel widely in the North Atlantic and could be exposed to naval activities in several ranges.

- Northeast Training Range Complex, where North Atlantic right whales forage,
- The Virginia Capes, Cherry Point, and Jacksonville-Charleston Operating Areas, which are situated consecutively along the migratory corridor for North Atlantic right whales (the later operating area overlaps with North Atlantic right whale critical habitat, where calving and breeding take place), and
- The Key West, Gulf of Mexico, Bermuda, and Puerto Rican Complexes have the potential to overlap the distribution of North Atlantic right whales, but presence within these areas is rare or undocumented.

Naval activities to which individuals could be exposed include, among others, vessel and aircraft transects, munition detonations, and sonar use. Responses by marine mammals could include no response, short-term and long-term behavioral responses and changes (altered vocal activity, changes in swimming speed and direction, respiration rates, dive times, and social interactions), temporary or permanent hearing loss, debris ingestion, ship-strike injury, and death.

Although naval vessels represent a small fraction of the total sound level and are designed to operate quietly, these ships are large and equipped with high-output sonar equipment such as ANISQS-53C tactical sonar, which produces signals at source levels of 235 dB re 1 $\mu Pa_{rms}$ at 1 m. The signals emitted from these devices have the potential to affect marine mammals in the action area; however, empirical data are limited.

## Vessel approaches – commercial and private marine mammal watching

Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational and scientific benefits, marine mammal watching is not without potential negative impacts. Whale watching has the potential to harass whales by altering feeding, breeding, and social behavior or even injure them if the vessel gets too close or strikes the whale. Another concern is that preferred habitats may be abandoned if disturbance levels are too high. In the Notice of Availability of Revised Whale Watch Guidelines for Vessel Operations in the Northeastern United States (64 FR 29270; June 1, 1999), NMFS noted that whale watch vessel operators seek out areas where whales concentrate, which has led to numbers of vessels congregating around groups of whales, increasing the potential for harassment, injury, or even the death of these animals. In addition to whale watching vessels, large cruise vessels also operate in waters along the eastern seaboard, and may pose a threat of ship strike or masking.

Several studies have specifically examined the effects of whale watching on marine mammals, and investigators have observed a variety of short-term responses from animals, ranging from no apparent response to changes in vocalizations, duration of time spent at the surface, swimming speed, swimming angle or direction, respiration rate, dive time, feeding behavior, and social behavior (NMFS 2006). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green. 2000; Corkeron 1995; Erbe 2002; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002a; Williams et al. 2002b). Foote et al. (2004) reported that southern resident killer whale call duration in the presence of whale watching boats increased by 10-15% between 1989-1992 and 2001-2003 and suggested this indicated compensation for a noisier environment. Finally, disturbance by whale watch vessels has also been noted to cause newborn calves to separate briefly from their mothers' sides, which leads to greater energy expenditures by the calves (NMFS 2006). Although numerous short-term behavioral responses to whale watching vessels are documented, little information is available on whether long-term negative effects result from whale watching (NMFS 2006).

## Ship-strike

Ship-strike is a significant concern for the recovery of North Atlantic right whales in the region. We believe the vast majority of ship-strike mortalities go unnoticed, and that actual mortality is higher than currently documented; Kraus et al. (2005) estimated that 17% of ship strikes are actually detected. The magnitude of the risks commercial ship traffic pose to large whales in the proposed action areas has been difficult to quantify or estimate. We struggle to estimate the number of whales that are killed or seriously injured in ship strikes within the U.S. Exclusive Economic Zone and have virtually no information on interactions between ships and commercial vessels outside of U.S. waters. With the information available, we know those interactions occur but we cannot estimate their significance to whale species.

Ship strikes are the largest single contributor to North Atlantic right whale deaths, accounting for approximately 35% of all known mortalities, even though right whales should be able to hear the sound produced by vessels (Ketten 1998; Knowlton and Kraus

2001; Laist et al. 2001; Richardson et al. 1995a). Some information suggests right whales respond only within very close proximity to ships (Nowacek et al. 2004a). Injury is generally caused by the rotating propeller blades, but blunt injury from direct impact with the hull also occurs. There have been 18 reports of North Atlantic right whales being struck by vessels between 1999 and 2005 (Cole et al. 2005b; Nelson et al. 2007a). Of the 17 reports that NMFS could confirm, right whales were injured in two of the ship strikes and killed in nine. Recent records show that from 2004-2008, there were 17 confirmed reports of North Atlantic right whales being struck with eight whales dying of their wounds and two additional right whales sustaining serious injuries (Glass et al. 2009). Deaths of females are especially deleterious to the ability of the North Atlantic right whale population to recover. For instance, in 2005, mortalities included six adult females, three of which were carrying near-term fetuses and four of which were just starting to bear calves, thereby representing a lost reproductive potential of as many as 21 individuals over the short term (Kraus et al. 2005). Voluntary recommendations for slower vessel speeds in the Bay of Fundy appear to be largely ignored (Vanderlaan et al. 2008a). Rules for seasonal (varies by location, but January through July) slowing of vessel traffic to 10 knots or changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to be capable of reducing ship strike mortality by 62% in the Bay of Fundy region; the same rule applies from November through April from Brunswick, Georgia to Jacksonville, Florida, where North Atlantic right whales go for calving and breeding. Speed rules also apply to medium and large ports along the eastern seaboard during this time frame when right whales migrate to and from northern feeding and southern breeding areas. Nearly a dozen shipping lanes transect through coastal waters of the southeastern U.S. from the North-South Carolina to Cape Canaveral, Florida.

## Scientific research and permits

Scientific research permits issued by the NMFS currently authorize studies of North Atlantic right whales in the North Atlantic Ocean, many of which extend into portions of the action area. Authorized research on ESA-listed whales includes close vessel and aerial approaches, biopsy sampling, tagging, ultrasound, and exposure to acoustic activities. Research activities involve non-lethal “takes” of these whales by harassment, with none resulting in mortality.

Table 2 describes the cumulative number of takes for North Atlantic right whales authorized in scientific research permits.

**Table 2.** Authorized North Atlantic right whale takes.

| Year | Approach | Biopsy | Suction cup tagging | Implantable tagging | Breath sampling |
|---|---|---|---|---|---|
| 2009 | 1,860 | 60 | 130 | 45 | 0 |
| 2010 | 6,875 | 110 | 230 | 45 | 80 |
| 2011 | 6,775 | 60 | 230 | 45 | 80 |
| 2012 | 5,575 | 50 | 190 | 45 | 80 |
| 2013 | 5,090 | 50 | 100 | 0 | 80 |
| Total | 26,175 | 340 | 880 | 180 | 320 |

Permit numbers: 10014, 1036-1744, 1058-1733, 594-1759, 605-1904, 633-1763, 775-1875, 948-1692, 14791, 14586, 14603, and 14233.

## Effects of the Proposed Action

Pursuant to section 7(a)(2) of the ESA, federal agencies must ensure, through consultation with the NMFS, that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed issuance of permit 15488 would authorize "takes" by harassment of North Atlantic right whales during the proposed research by the GDNR-WRD by directed approach, biopsy, and photoidentification. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed actions, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent. The purpose of this assessment and, ultimately, of this Opinion is to determine if it is reasonable to expect the proposed action to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned about behavioral and physiological disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The ESA does not define harassment nor has the NMFS defined the term pursuant to the ESA through regulation. However, the Marine Mammal Protection Act

of 1972, as amended, defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is almost identical to the U.S. Fish and Wildlife Service's regulatory definition of "harass"[1] pursuant to the ESA. For this Opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

Individuals may respond to stressors in a variety of ways, some of which have more significant fitness consequences than others. For example, evasion of an approaching vessel would be more significant than slow travel away from the same stressor due to increased metabolic demands, stress responses, and potential for habitat abandonment that this response could or would entail. As described in the *Approach to the assessment*, the universe of likely responses is considered in evaluating the fitness consequences to the individual and (if appropriate), the affected population and species as a whole to determine the likelihood of jeopardy.

## Potential stressors

The assessment for this consultation identified several possible stressors associated with the proposed research activities, including

1. aerial transit during proposed activities
2. surface vessel transit during proposed activities
3. close approaches to listed whales by research vessels
4. collection of blubber biopsy samples

Based on a review of available information, this Opinion determined which of these possible stressors would be likely to occur and which would be discountable or insignificant.

We do not expect that vessel transits pose a significant risk of ship strike to North Atlantic right whales under the proposed actions. Operators and observers will search for marine mammals while underway and we feel confident in the ability of operators to locate, identify, and avoid direct contact with individuals. While in close proximity to marine mammals in undertaking the proposed research, operators would be moving slowly and deliberately in ways in which the vessels would approach, but not physically contact listed or proposed marine mammals. A North Atlantic right whale was struck by a research vessel in 2009/2010 during the course of similar research in the northeastern U.S. However, this is the only such incident (or any incident that we are aware of

1 An intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3)

including other authorized research on the species) in decades of intensive research on North Atlantic right whales. We therefore discount the potential for ship strike in association with the proposed actions to target species.

Accordingly, this consultation focused on the following stressors likely to occur from the proposed seismic activities and may adversely affect North Atlantic right whales: overflights by survey aircraft; close approaches by research vessels; and collection of blubber biopsy samples.

## Exposure analysis

The proposed action is to permit biopsy, close approach, photoidentification, and behavioral observations of North Atlantic right whales as outlined in Table 3.

**Table 3**. Number of individuals proposed to be taken by species, life stage, and action under Permit 15488.

| Species-population | Life stage | Number of individuals taken annually | Action |
|---|---|---|---|
| North Atlantic right whale (*Eubalaena glacialis*)-North Atlantic | All | 350 | Close approach-vessel, behavioral observation, photoidentification, passive acoustic recording |
| | Juvenile/adult | 50 | Close approach-vessel, behavioral observation, photoidentification, passive acoustic recording, biopsy |
| | Non-neonate calf >1 month old primarily, older individuals secondarily | 20 | Close approach-vessel, behavioral observation, photoidentification, passive acoustic recording, biopsy |

Under the proposed permit, an individual of any age class or sex would be allowed to be approached by vessel up to 10 times per year, but the Permits Division expects most individuals are expected to be approached between one and three times. Unfortunately, researchers cannot identify an individual until after it has been approached and photo-identified (informal identification is routinely done in the field, but formal identification frequently is done later on shore). A binomial analysis indicates that an individual may be approached up to six times annually (15 times over the life of the permit), but would most likely be approached once per year and five times over the life of the permit. Based upon field methods used to identify individuals in the field prior to biopsy sampling, we do not expect any individual to be inadvertently re-biopsied under the proposed permit. However, the applicant states that a 20% “miss” rate for biopsy sampling is to be expected; additional attempts at biopsy are not precluded by the proposed permit. The permit would be conditioned to minimize harassment from biopsy activities to no more than three times per day. Permit conditions also stipulate that aerial surveys must be flown at altitudes above 305 m, but may briefly descend to 224 m and that if a response

to aerial survey is observed, the survey aircraft must leave the area. All biopsy tips must be disinfected prior to use. Biopsy attempts must be discontinued if repetitive strong reactions are found. All age and sex classes may be approached via aerial and vessel survey, although calves would be of particular interest to obtain biopsy samples and a catalog of individuals needing biopsy is maintained on a daily basis.

## Response analysis

As discussed in the *Approach to the assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after exposure to an action's effects on the environment or directly on listed species themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal (physiological), or behavioral responses that might result in reducing the fitness of listed individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response or more serious physiological changes with chronic exposure to stressors), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Mullner et al. 2004), and the death of individual animals (Bearzi 2000; Daan 1996; Feare 1976). Stress is an adaptive response and does not normally place an animal at risk. However, distress involves a stress response resulting in a biological consequence to the individual. The mammalian stress response involves the hypothalamic-pituitary-adrenal (HPA) axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones cortisol, adrenaline (epinephrine), glucocorticosteroids, and others (Busch and Hayward 2009)(Gulland et al. 1999; Morton et al. 1995; St. Aubin and Geraci 1988; St. Aubin et al. 1996; Thomson and Geraci 1986). These hormones subsequently can cause short-term weight loss, the liberation of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, and alertness, and other responses (Busch and Hayward 2009; NMFS 2006g)(Cattet et al. 2003; Delehanty and Boonstra 2009; Elftman et al. 2007; Fonfara et al. 2007; Kaufman and Kaufman 1994; Mancia et al. 2008; Moe and Bakken 1997; Noda et al. 2007; Thomson and Geraci 1986)(Dierauf and Gulland 2001; Omsjoe et al. 2009). In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer et al. 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 1998; Cowan and Curry 2002; Cowan and Curry 2008; Herraez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the HPA axis may persist for weeks

(Dierauf and Gulland 2001). Mammalian stress levels can vary by age, sex, season, and health status (Gardiner and Hall 1997; Hunt et al. 2006; Keay et al. 2006; Kenagy and Place 2000; Nunes et al. 2006; Romero et al. 2008; St. Aubin et al. 1996). Smaller mammals tend to react more strongly to stress than larger mammals (Peters 1983); a trend reflected in data from Gauthier and Sears (1999) where smaller whale species tended to react more frequently to biopsy than larger whales. Stress is lower in immature right whales than adults and mammals with poor diets or undergoing dietary change tend to have higher fecal cortisol levels (Hunt et al. 2006; Keay et al. 2006; Kitaysky and Springer 2004).

**Close approach-aerial surveys**

Few published data are available to evaluate the responses of listed marine mammals to aircraft overflights. Malme et al. (1983) made an opportunistic evaluation on a bowhead whale group. In this event, a circling single-engine aircraft descended from roughly 400 m (above the normal altitude generally used in proposed aerial surveys) to 60 m (well below the minimum altitude proposed for permitted aerial surveys). Once the aircraft descended and approached the whales at its closest point, the group discontinued its behavior and split into two groups. The groups rejoined and continued their prior behavior immediately after the departure of the aircraft. Richardson et al. (1985) found bowheads to respond frequently to Islander survey aircraft approaches below 305 m, infrequently at 457 m, and not at all at 610 m; responses were normally hasty dives and sometimes gradual departure from the area. Blow interval may also decrease upon aircraft descent. Payne et al. (1983) found southern right whales to rarely react strongly to survey aircraft flying at 65-130 m. Richter et al. (2006) found sperm whales (specifically transient sperm whales) to briefly increase their time at the surface and take 20 seconds longer during their dives to start “clicking” (presumably related to prey detection), although they determined that their findings were not biologically meaningful. They did note that habituation to both vessel and aerial approaches likely occurred in “resident” individuals. Luksenburg and Parsons (2009) found that across cetacean species, most respond (when they respond) by diving. Smaller groups respond strongly less often than do larger ones, as do individuals in shallow versus deep water, mothers with calves versus other group types, when individuals were initially resting or milling, and when aircraft fly at lower altitude. Sperm whales responded in 28% (7 of 25) cases to survey aircraft (mostly by diving) and false killer whales responded in <29% of overflights (Smultea et al. 2008). Overflight and circling at 235-335 m above a sperm whale group by a Skymaster survey aircraft elicited a group defensive formation from a sperm whale pod. Bowhead whales responded in 2.2% of 507 observations to Twin Otter overflights, with most responses of short surfacing, abrupt dives, or heading away from the plane when the aircraft was flying at below 182 m and less than 250 m laterally from target individuals (Patenaude et al. 2002). Beluga whales have been found to respond in 3.2% of 760 overflights by immediately diving with a tail thrash, unusual turns or changes in heading, turning to look upwards, or other behavioral reactions. Most responses were from the same aircraft type and at the same ranges previously mentioned for bowheads, with direct overflights causing the most conspicuous responses. After measuring sound detected via hydrophone during aircraft overflights, it was determined that bowheads would likely hear a plane flying directly overhead at 150 or 300 m altitude, but belugas could perhaps just barely hear a plane at 300 m. An aircraft’s

shadow may cause cetaceans to respond as well (Luksenburg and Parsons 2009).

Most pertinent to this analysis are data collected over the past 15 years by various researchers conducting aerial surveys for North Atlantic right whales and reported in annual reports to the Permits Division. We are aware of thousands of sightings of North Atlantic right whales by researchers since 1995 utilizing methodologies generally similar to those in the proposed permit, without a single instance of a response noted. This, combined with a low incidence of response from other species as well as guidance from expert opinion (Laura Morse, NMFS, pers. comm.; Trisia Naessig, EcoHealth Alliance, pers. comm.) leads us to conclude that North Atlantic right whales will not respond to aerial surveys.

**Close approaches-surface vessel**

Vessel approaches have the potential to induce behavioral and possibly physiological changes in individuals being targeted. The degree to which individuals are disturbed is highly variable. Whales may respond differently depending upon what behavior the individual or pod is engaged in before the vessel approaches (Hooker et al. 2001; Wursig et al. 1998), the degree to which they have become accustomed to vessel traffic (Richter et al. 2006), and between species or individuals (Gauthier and Sears 1999). Overall, reactions include little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging, respiratory patterns, and may include aerial displays like breaching and lobtailing (Baker and Herman. 1989; Best et al. 2005; Brown et al. 1991; Clapham and Mattila 1993; Jahoda et al. 2003). Only Jahoda et al. (2003) found effects of more than a few minutes, with fin whales failing to return to baseline behaviors after one hour of observation in some cases, in spite of the fact that Gauthier and Sears (1999) found fin whales to be less responsive than humpbacks.

North Atlantic right whales may not respond at all to kayaks, sailing sloops, or steel-hulled diesel-powered vessels approaching within five meters, although other individuals (possibly under different contexts) have responded to the same diesel-powered vessel from 50 m away, usually by turning away from the path of the ship (Goodyear 1993a). Baumgartner and Mate (2003b) found that 71% of 42 North Atlantic right whales approached (and sometimes tagged) in a rigged inflatable boat within 10 m did not overtly respond. Of those that did respond, behaviors included head lifts and lunges, back arching, rolling, and fluke beats. Feeding dive durations were also shorter by 13-17% in the dive following approach/tagging, but no difference was found in the duration of subsequent dives. Mate et al. (1997a) found that although North Atlantic right whales generally responded to and avoided close approach, the level of response varied. Watkins (1986) found that whales are more responsive to approach when they are inactive and less responsive when feeding or socializing. Cumulative annual report data for a variety of North Atlantic right whale researchers (including the applicant working under prior and existing permits) utilizing diverse methodologies between 1995 and 2010 and over 5,000 vessel approaches support an overall response rate of roughly 4%.

Information on contextual responses is generally lacking for North Atlantic right whales, but relatively abundant for humpback whales. Responses by humpback whales likely depend upon a given individual's prior experience and current situation (Clapham and

Mattila 1993). The use of smaller, outboard-powered vessels (presumably louder) elicited more frequent and stronger responses to biopsy attempts than larger, inboard-powered vessels; sex was not a factor in response frequency or intensity (Cantor et al. 2010). Sudden changes in vessel speed and direction have been identified as contributors to humpback whale behavioral responses from vessel maneuvering (Watkins 1981a). The more active the group, the more easily it was disturbed; however, Cantor et al. (2010) found structuring in the response rate of various individuals in mating groups, with male response becoming progressively less frequent with increasing degree of dominance in the mating group. Mother-calf pairs were the most easily disturbed group, followed by all adult groups, adult-subadult mixes, and all subadult groups (Felix 2001). Weinrich et al. (1991) and (1992), Cantor et al. (2010), as well as Krieger and Wing (1984) found feeding animals to be least responsive, although data from these studies was contradictory when evaluating responses while resting or on breeding grounds. The first two cited studies also found that respiratory parameters are not good indicators of responsiveness due to the large natural variance associated with them. However, numerous studies have identified significant changes in respiration and diving in association with vessel traffic (see Bauer and Herman (1986) for a summary). On several occasions, research trips conducted by Krieger and Wing (1984) had to actively avoid collisions with humpbacks, although whales presumably were aware of the vessel's presence. Single or paired individuals may respond more than larger groups (Bauer and Herman 1986). Würsig et al. (1998) found milling or resting cetaceans to be more sensitive.

Repeated exposure can have a cumulative effect that is greater than the sum of individual exposures, eliciting responses that are more significant for individuals and populations, although Cantor et al. (2010) did not find a difference in response based upon re-exposure. However, humpback whales have vacated areas where relatively high boat traffic and human activity occurs (Herman 1979). Major declines and distributional shifts in Glacier Bay, Alaska were correlated with a rapid and significant increase in vessel traffic from 1976 to 1978, whereas humpback whales in other nearby areas with less traffic did not undergo such changes (Bauer and Herman 1986). It should be noted that potentially reduced prey resources may also have been important in this redistribution (Bauer and Herman 1986). Matkin and Matkin (1981) did not find a correlation between humpback whale behavior and recreational vessels.

The close approach of vessels also presents the possibility that valuable acoustic information could be missed by the target individual(s) due to masking by the vessel's engines. The acoustic properties of vessels likely to be used by the applicant are similar to the frequency range utilized by target marine mammals during vocalization such that communication could be impaired (Clark et al. 2009; Dunlop et al. 2010a). Parks et al. (2010) and Anonymous (2010) found that North Atlantic right whales temporarily modify the amplitude of their calls, making them louder with increased background noise (including noise from vessel traffic), as well as shifting call frequency over longer time frames. Killer whales in high traffic areas have been found to increase call duration or call amplitude in response to increased anthropogenic noise in the marine environment (Erbe 2002; Foote et al. 2004; Holt et al. 2009). As a broader issue, increased anthropogenic noise in the marine environment has the potential to reduce the range over which individuals communicate, conceivably increasing calf mortality, altering ideal

group or individual spacing, and making identification and selection of mates more difficult or impossible (Croll et al. 2001).

At the level of an individual vessel, such as that proposed for use by the applicant, we expect masking to result in minimal impact for several reasons that will likely mitigate the significance of vessel noise. Operations would be conducted at low speed with a minimum of throttling and directional changes. Low vessel speed means that less cavitation will occur, which is the primary source of sound energy emitted by motorized vessels (Mazzuca et al. 2001; Ross 1976). Slower speeds and fewer directional changes will also result in fewer changes in sound characteristics, which are believed to add to the significance of vessel noise and its impact to cetaceans. Most interactions with target individuals should be brief (a few to few dozen minutes) before the vessel breaks contact following photoidentification, biopsy, and/or biopsy.

We expect that the response rate of North Atlantic right whales to vessel approach to be similar to the historical average of 4% (14 individuals responding out of the 350 annual approaches proposed to be authorized). A few additional individuals may respond based upon specific circumstances not well reflected in cumulative data. Although information from humpback whales indicates that mother/calf pairs are among the most easily-disturbed groups, North Atlantic right whale biopsy research has focused on these groups for several years and the bias towards this group type should be reflected in the overall response rate. We also expect that responses will be similar to the low- to-moderate level behavioral responses previously observed. As described in the *Exposure analysis*, individuals could plausibly be exposed to vessel approach up to five times per year and are likely to be re-exposed once. We expect that individuals may respond to these re-exposures as well (up to the number of re-exposures, but likely less).

**Biopsy**

Biopsy sampling not only has the potential to disrupt behavior, but also breach an individual's integument. Because of this, physiological or pathological responses as well as behavioral ones are possible. We know of only one published report of a cetacean death following biopsy sampling, when the dart penetrated the muscle mass of a female common dolphin (*Delphinus delphis*), which may have resulted in vertebral trauma and severe shock (Bearzi 2000). The individual had relatively thin blubber, permitting deeper penetration than was desired and sticking of the dart. Apart from the one mortality, there is not even evidence of infection at the point of penetration or elsewhere among the many whales sighted in the days following biopsy sampling (Weller 2008). The risk of infection is thought to be minimized by sterilizing dart tips before sampling occurs. In general, healing is rapid {roughly one week`, scarring thereafter`; \Noren, 2011 #4}.

North Atlantic right whales showed immediate, minor behavioral response to biopsy darting 19% of the time in 241 attempts and no reaction in 81% of hits and misses (Brown et al. 1991). Reactions include twitches, increased swimming speed and dives, back arches and dives, tail flicks, lobtails, and turning away from the tagging vessel (Brown et al. 1991). More than 50% of individuals had a hard tail flick; an unusual behavior for this species. Dives also became longer relative to surface times. However, return to baseline behavior generally occurred rapidly (Brown et al. 1991). It should be noted, though, that one individual lobtailed for 40 minutes after a missed biopsy attempt

where monofilament line attached to the arrow trailed after the animal (Brown et al. 1991). Reeb and Best (2006) also documented generally no or low- to moderate-level responses of right whales to pole biopsy techniques. Demographic differences in responses have been identified in southern right whales, with greater response in singletons versus groups and cow/calf pairs responding more strongly than other groups (Best et al. 2005). Overall, changes in reproductive output by female right whales was not found, although the power to detect differences was low (Best et al. 2005).

Annual report data from 1995-2010 support a response rate of 27.5% over a variety of techniques and contexts, as well as several hundred attempts (encompassing most of the data from Brown et al. 1991b). Responses were generally low-level to moderate, including flinches, tail flicks and swishes, acceleration, rolling, pectoral fin slaps on the water, movement away, diving, and approaches. We cannot determine if a difference exists between the response rate of calves versus other age classes, but reactions types do not appear to be different. Based upon this and information from the general literature, we expect 27.5% of the 50 juveniles/adults (14) and 20 calves (6) will respond with low- to moderate-level behavioral responses similar to those described above. A few additional individuals may respond based upon specific circumstances not well reflected in cumulative data. As previously mentioned, we do not expect individuals to be re-exposed to biopsy unless the prior attempt failed to obtain a sample.

**Cumulative effects**

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Sources queried for the information herein include the U.S. Census Bureau and Department of Labor, as well as Lexis-Nexis information system. With the latter (which was our source for state legislation in Florida, South Carolina, and North Carolina), we reviewed bills passed in 2010 and pending bills under consideration were included as further evidence that actions "are reasonably certain to occur". Bills that died in process or were vetoed are not included in our review.

Regulatory changes alter the environment under which future actions can occur, including development of commerce and industry. Florida's legislature is considering a possible amendment to the state constitution prohibiting marine oil exploration, drilling, and extraction.

Based upon 2000 U.S. census data (USCB 2005a; USCB 2005b; USCB 2005c), the southeast U.S. was predicted to contain 55.7 million people in 2010. Population growth is predicted to remain above 10% through 2030 and will be greatest in Florida and North Carolina. Much of the regional population is contained in concentrated metropolitan centers. Urban growth is predicted to be extensive in the mid-Atlantic; 12 metropolitan areas experienced population growth of 3%/year or greater from 2000 to 2007, including the Atlanta area, once considered the most rapidly developing area in human history. However, half of these urban centers were in Florida. Cities of over one million people that grew at a rate of 1%/year or greater from 2000 to 2007 included Raleigh (4.49%/year), Atlanta (3.47%/year), Charlotte (3.44%/year), Orlando (3.37%/year),

Jacksonville (2.27%/year), Tampa-St. Petersburg (1.96%/year), Richmond (1.51%/year), and Miami, (1.16%/year). This rapid and concentrated population increase places much larger demand upon natural systems. Wastewater systems must handle larger loads of sewage. As soil is covered by asphalt and concrete, run-off must be channeled into local stormwater drains increasing contaminant load in streams. Regional areas of development are frequently in low-elevation locations, limiting water retention and movement. Both of these are sources of concern for sediment and contaminants entering local waterways and flowing into rivers, estuaries, and nearshore marine habitats where North Atlantic right whales and their critical habitat are found.

Whale watching has the potential to significantly expand, generating an additional 413 million dollars globally and generating an additional 5,700 jobs (Cisneros-Montemayor et al. 2010). Similarly, alternative energy projects such as ocean current, wave, and tidal energy projects are expected to increase within the action area and will require federal permits (e.g., Federal Energy Regulatory Commission (FERC)), so these actions are not included in the Cumulative Effects section of this Opinion. After reviewing available information, NMFS is not aware of effects from any additional future non-federal activities in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future.

**Integration and synthesis of effects**

As explained in the *Approach to the assessment* section, risks to listed individuals are measured using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the population(s) those individuals represent or the species those populations comprise (Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment. If possible reductions in individuals' fitness are likely to occur, the assessment considers the risk posed to population(s) to which those individuals belong, and then to the species those population(s) represent.

The Permits Division proposes to issue a permit to Dan Forster of the GDNR, WRD for directed take of North Atlantic right whales, who are critically endangered throughout their range. The *Status of listed resources* section identified commercial whaling as the primary reason the population size is a fraction of its former abundance. Other threats to the survival and recovery of North Atlantic right whales include ship strike, entanglement in fishing gear, as well as toxic chemical burden and biotoxins. North Atlantic right whales are expected to face area-specific threats identified in the *Environmental baseline*, including habitat degradation, whale watching, research activities, seismic surveys, oil and gas exploration, naval activities, climate change, human noise sources, ship strike, and entanglement. Actions that are reasonably likely to occur were described in the *Cumulative effects* section.

The *Exposure analysis* describes the actions proposed to be undertaken to North Atlantic right whales: close approaches by survey aircraft of any age/sex, close approaches by research vessel of any age/sex, and/or biopsy (see Table 3 on page 23 for age class

limitations on biopsy activities).

The *Response analysis* considered that stressors to which targeted individuals would be exposed will likely cause behavioral, physiological, and displacement responses. Aerial surveys are expected to cause no response from any individual. Vessel approaches frequently result in behavioral changes in listed whales, with most approaches resulting in no response or apparently "minor" to "moderate" responses (including, but not limited to head lifts and lunges, back arching, rolling, and fluke beats). There is compelling evidence that cumulative vessel approaches (Bauer and Herman 1986; Herman 1979) or additive effects of vessel approach and other anthropogenic stressors (Fraker et al. 1982) can have more significant effects, including the displacement of humpback whales from Alaskan foraging areas and gray whales from summer lagoon habitat (Bauer and Herman 1986; Reeves 1977). The presence of additional anthropogenic stressors, such as commercial vessel traffic are likely to induce additional disturbance on potential target individuals (Fraker et al. 1982; NMFS 2008a). Although it is possible that individuals are being displaced from more preferable habitat, we have no evidence to suggest this. The number and severity of responses to vessel approaches that listed individuals will experience is small. This is especially true in comparison to the other anthropogenic and natural stressors with which individuals must cope. Coupled with trends suggesting recovery or stability for North Atlantic right whales, the continuation of close approach activities under the proposed permit are not expected to measurably hamper survival or recovery of the species.

In addition to the stressors placed upon targeted individuals from vessel and aerial approaches, a portion of the same individuals will be further exposed to stressors associated with biopsy. The *Response analysis* found that responses by whales to these activities are similar to those of vessel approach and are frequently difficult to differentiate (Goodyear 1981; Goodyear 1993b; Hooker et al. 2001; Mate et al. 1997b; Watkins 1981b; Watkins et al. 1984). In addition, not all individuals respond to biopsy, meaning that a fraction of targeted individuals are not expected to show an overt response to a combined approach and biopsy action. We do expect all individuals to at least be aware of the vessel's approach and may undergo a low-level stress reaction as a result of a large unknown object in close proximity to individuals. Information available to us does not support behavioral responses by an individual being more severe when additional activities (such as biopsy) are added to vessel approach, although we do expect more frequent responses to the combined activities versus to approach alone.

Overall, we expect all targeted whales to experience some degree of stress response to some approach and biopsy attempts. We also expect some of these individuals to undergo short-term behavioral responses to these activities. We do not expect displacement of individuals from the action area as a result of the proposed action. Individuals responding in such ways may temporarily cease breeding, resting, nursing, or otherwise disrupt vital activities. However, we do not expect that these disruptions will cause a measureable impact to any individual's fitness. We expect all biopsied individuals to experience additional physiological reactions associated with foreign body penetration into the blubber and possibly muscle, including inflammation, and scar tissue development. We do not expect any single individual to experience a fitness consequence as a result of the proposed actions and, by extension, do not expect

population-level effects.

**Conclusion**

After reviewing the current status of endangered North Atlantic right whales in the *Status of Listed Resources*, the *Environmental Baseline* for the action area, the effects of the proposed research programs, and the *Cumulative Effects*, it is the NMFS' opinion that issuing Permit 15488 (D. Forster, GDNR-WRD) is not likely to jeopardize the continued existence of North Atlantic right whales or the destruction or adverse modification of designated critical habitat.

## Incidental Take Statement

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibits the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

We do not expect incidental take of threatened or endangered species as a result of the proposed actions.

## Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The following conservation recommendations would provide information for future consultations involving the issuance of marine mammal permits that may affect endangered whales as well as reduce harassment related to research activities:

1. *Determination of take numbers.* The Permits Division should examine its methodologies for determining take numbers and coordinate with the Endangered Species Division to ensure that the take numbers better reflect a level of exposure which has occurred in the past under similar or identical GDNR-WRD actions as evidenced by annual reports.
2. *Identify responses by listed individuals to permitted actions.* The Endangered Species Division recommends that annual reports submitted to the Permits Division require detail on the response of listed individuals to permitted activities. A minimum of general comments on response can be informative regarding methodological, population, researcher-based responses in future consultations. The number and types of responses observed should be

summarized and include responses of both target and non-target individuals. This will greatly aid in analyses of likely impacts of future activities.

In order for NMFS Endangered Species Division to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Permits Division should notify the Endangered Species Division of any conservation recommendations they implement in their final action.

## Reinitiation Notice

Pursuant to the provisions of section 10 of the ESA and MMPA, this concludes formal consultation on NMFS' proposal to issue Permit 15488 to the Georgia Department of Natural Resources, Wildlife Resources Division. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, NMFS Permits, Conservation and Education Division must immediately request reinitiation of section 7 consultation.

## Literature Cited


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